

<p align="center">LLNL Environmental Restoration Division Standard Operating Procedure</p>	<p align="center">TITLE: Water-Level Measurements</p>
<p>APPROVAL _____ Date _____</p> <p>Environmental Chemistry and Biology Group Leader</p>	<p align="center">PREPARERS: S. Gregory, E. Nichols*, and E. Walter</p> <p align="center">REVIEWERS: M. Brazell, R. Brown**, E. Christofferson**, T. Carlsen, J. Chiu*, V. Dibley, J. Duarte, B. Failor**, C. Garcia**, G. Howard, S. Mathews**, D. Ramsey**, and B. Ward**</p>
<p>APPROVAL _____ Date _____</p> <p>Division Leader</p> <p>CONCURRENCE _____ Date _____</p> <p>QA Implementation Coordinator</p>	<p align="center">PROCEDURE NUMBER: ERD SOP-3.1</p> <p align="center">REVISION: 2</p> <p align="center">EFFECTIVE DATE: December 1, 1995</p> <p align="center">Page 1 of 11</p>

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1.0 PURPOSE

To determine the depth to water from a standard measuring point in an open borehole, cased borehole, monitor well, or piezometer.

2.0 APPLICABILITY

This procedure is applicable for the collection of ground water elevation data for use during ground water sampling, as well as for use in constructing graphical displays (i.e., potentiometric surface maps and monitor well hydrographs).

3.0 REFERENCES

- 3.1 U.S. EPA (1986), *RCRA Ground water Monitoring Technical Enforcement Guidance Document*, Washington, D.C.

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- 3.2 U.S. EPA (1992), *RCRA Ground Water Monitoring: Draft Technical Guidance*, Washington, D.C. (EPA/530-R-93-001).

4.0 DEFINITIONS

4.1 Piezometer

A small diameter monitor well (typically 2" or 4.5" in diameter) primarily used for the purpose of determining ground water elevation.

5.0 RESPONSIBILITIES

5.1 Division Leader

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

5.2 Field Personnel

The field personnel are responsible for properly performing water-level measurements in compliance with all applicable regulations and procedures and ensuring that the resulting data accurately represent the true hydrogeologic conditions.

5.3 Group Leader/Study Area Leader/Task Leader/ORAD Analyst (Water Guidance and Monitoring Group)

Determines which ground water installations require ground water elevation monitoring, and sets the schedule for the collection of this data.

5.4 Hydrogeologic Group Leader (HGL)/Environmental Chemistry and Biology Group Leader (ECBGL)

The HGL and ECBGL are responsible for approving the water-level measurement equipment.

5.5 Sampling Coordinator (SC)

The SC's responsibility is to verify the accuracy of the water-level measurement(s) prior to database entry, and must compare the new data to historical data and decide if it is consistent or suspect. The SC is also responsible for the generation of all applicable field sheets.

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6.0 PROCEDURE

6.1 Generally, water-level measurements from boreholes, piezometers, or monitor wells are used to construct potentiometric surface maps (ground water elevation contour maps for water table aquifers), and well hydrographs (plots of water level vs. time). Therefore, water-level measurements at a given site should be collected within the shortest time period possible. This practice is adequate if the magnitude of change is small over that period of time. There are other situations, however, which necessitate that all measurements be taken within an extremely short time interval. These are:

- A. Rapid changes in atmospheric pressure.
- B. Aquifers affected by a surface water impoundment and/or unlined ditches.
- C. Aquifers stressed by intermittent pumping of production wells.
- D. Aquifers actively being recharged due to precipitation.

6.2 Office Preparation

- 6.2.1 If the water-level data are being collected for the entire site, the Water-Level Measurement Log, obtained from the SC, should be used (Attachment A). If the data are being collected as part of a hydraulic test, consult SOP 3.2, 3.3, or 3.4, as appropriate. If the data are being collected during ground water sampling, SOP 2.1 or 2.7 should be followed, as appropriate.
- 6.2.2 Obtain a Water-Level Measurement Log that includes the previous month's water levels from the SC or the Data Management Group (DMG).
- 6.2.3 Obtain the equipment on the Equipment Checklist (Attachment B).
- 6.2.4 Make sure water-level measuring equipment is in good operating condition.
- 6.2.5 Review appropriate sections of the Site Safety Plan.
- 6.2.6 Check with the Control Point Operator and the Building Supervisors for permission to work in their area as appropriate (see SOP 4.1, "General Instructions for Field Personnel").
- 6.2.7 Determine if there are any wells that are scheduled for sampling on the same day as the water-level measurement and make other arrangements with the SC.

6.3 Field Preparation

- 6.3.1 Review contaminant plume maps and refer to contaminant levels indicated on the water-level field sheets to determine the order water-level measurements should be taken. Whenever possible, start at those wells that are the least contaminated and work towards more contaminated areas as indicated by the SC.
- 6.3.2 Clean all equipment per SOP 4.5, "General Equipment Decontamination" before use.

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6.4 Operation

- 6.4.1 Obtain proper personal protective equipment (PPE). For this operation, protective latex gloves are usually sufficient unless otherwise specified by the SC. To avoid cross contamination of wells and personnel exposure, gloves should be changed at the first sign of degradation, if they become torn, or when moving to a different well.
- 6.4.2 The device used to measure water levels should attain an accuracy of 0.01 ft. A steel tape or an electric sounder can be used to measure water levels, but this SOP concerns only the use of an electric sounder. The use of an alternative device must be approved by the HGL or the ECBGL, and procedures for their use must be documented.
- 6.4.3 For Site 300, water-level indicators can be acquired at Building 833. When possible, the same portable water-level measurement device should be used for all measurements. However, Site 300 is divided into two areas with respect to water levels. In the northern portion of the site, also referred to as the East/West Firing Area (EWFA), tritium is the prevailing contaminant. The southern portion of the site is predominately contaminated with volatile organic compounds (VOCs). In order to prevent cross contamination between the two areas, the water-level indicators have been marked and dedicated for specific sections. All water-level indicators marked "3H" or "NORTHERN" are intended for use in the EWFA. Similarly, the indicators marked "SOUTHERN" are intended for use in the southern portion of the site. If an indicator is dedicated to a particular section of the site, or a particular well, it will also be marked accordingly. The SC will provide a separate Water-Level Measurement Log for each portion of the site. One Water-Level Measurement Log will be labeled "EWFA" and the other will be labeled "SOUTHERN."
- 6.4.4 For the Livermore Site, water-level indicators can be acquired from the SC. The same water-level device may be used site wide, except in areas of heavy gasoline contamination. In the these instances the SC should be consulted for an alternate device.
- 6.4.5 Each device must be calibrated by comparing measurements to those of a reference device on a quarterly basis and logged in the Water-Level Indicator Calibration Log Book (SOP 4.8, "Calibration and Maintenance of Field Instruments Used in Measuring Parameters of Surface and Ground Water and Soils").
- 6.4.6 Unlock and open the steel protective casing. Remove the well casing cap.
- 6.4.7 Make sure there is a Well Entry Logbook attached to the inner side of the steel protective casing. A Well Entry Logbook is kept in each well, locked inside the well casing. When a well is entered into the logbook, write the date, purpose, and name of the operator in the logbook, and replace it in the well when operations are complete.
- 6.4.8 Prior to measurement, water levels in piezometers and monitor wells should be allowed to stabilize for a minimum of 24 h after well development or sampling . In low-yield situations, recovery may take longer.
- 6.4.9 A survey shiner (a shiny, metal well identification tag) can be found on the protective concrete pad around the casing and is the surveyed reference point.

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The measuring reference point is located on the top of the steel protective casing (stove pipe). This is the point of measurement (POM) to be used when obtaining water-level measurements. Any deviation from this measuring point must be documented on the Water-Level Measurement Log (Attachment A) and reported to DMG and the SC.

- 6.4.10 Measure the distance from the water surface to the measuring reference point (the top of the protective steel casing) by placing a steel indicator reference bar (or something comparatively straight and rigid) over the top of the stovepipe (protective steel casing) then, lower an electric water-level meter or equivalent (i.e., steel tape) into the sounding port as marked. Insertion into the pump discharge line (usually of the same diameter) will give a false reading. Using the electronic water-level indicator, a light (usually red) will shine on the reel of the water-level meter, and an audible buzz will sound when water is encountered. Slowly move the line up and down along the side of the reference bar until the exact point at which the buzz is heard is located. Obtain the depth-to-water measurement by referencing the markings on the water-level indicator line to the buzzing tone. Use the bottom of the reference bar as the point of measurement. Use a ruler on the line if finer measurement resolution is required. Check the measurement a second time for verification. The measuring device may then be removed and cleaned (Section 6.5.1).
- 6.4.11 Compare the new measurement to last month's water level as displayed on the Water-Level Measurement Log (Attachment A) and to previous water-level measurements written in the Well Entry Logbook.
- 6.4.12 Record measurement, date, and any notes next to last month's water level on the Water-Level Measurement Log (Attachment A). If the water-level measurement seems suspect or if there is a 0.5 ft difference from the last reading, then remeasure three more times. Place three check marks next to the well ID on the Water-Level Measurement Log to indicate that triplicate measurements were taken.
- 6.4.12 Record measurement, date, reason for entry, and initials in the Well Entry Logbook.
- 6.4.13 Replace well cap and lock the steel protective casing.

6.5 Field Post Operation

- 6.5.1 Rinse all downhole equipment with de-ionized water (over barrel to catch rinse water) and dry with disposable towels. If moderate to high levels of VOC contamination is present in the area, the water-level indicator must be decontaminated by washing the probe and the length of line that has been down hole with de-ionized water and detergent soap. If contamination level is uncertain, clean equipment per SOP 4.5, "General Equipment Decontamination." Dispose of all rinsates per SOP 4.7A, "Livermore Site Treatment and Disposal of Well Development and Well Purge Fluids" or SOP 4.7B, "Site 300 Treatment and Disposal of Well Development and Well Purge Fluids", as appropriate.
- 6.5.2 Store water-level measuring device in a clean, protected area during transport to the next well and after work is completed.

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6.6 Office Post Operation

Forward copies of the Water-Level Measurement Log to DMG. Return logbooks to the SC.

7.0 QA RECORDS

- 7.1 Well Entry Logbook
- 7.2 Water-Level Measurement Log
- 7.3 Water-Level Indicator Calibration Log Book

8.0 ATTACHMENTS

Attachment A—Example of Water-Level Measurement Log

Attachment B—Equipment Checklist

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Attachment A

Example of Water-Level Measurement Log

1-Apr-95

WATER LEVEL MEASUREMENT LOG

WELL DESIGNATION	DEPTH TO H2O (TOSP)	DATE H2O LEVEL TAKEN	H2O ELEVATION	SHINER ELEVATION	POM ELEVATION	TOP OF FIXED STRUCTURE	3H SAMPLE NOTES
K1-01C	105.30	Apr-95	970.78	1074.08	1076.08	2.00	Y N
K1-02B	39.36	Apr-95	1067.75	1105.11	1107.11	2.00	Y N
K1-03	142.00	Apr-95	965.93	1105.93	1107.93	2.00	Y N
K1-08	158.35	Apr-95	964.25	1120.58	1122.60	2.02	Y N
K2-01C	69.02	Apr-95	982.17	1049.19	1051.19	2.00	Y N
K2-03	55.57	Apr-95	1011.07	1064.64	1066.64	2.00	Y N
K2-04S	30.06	Apr-95	1061.89	1088.95	1091.95	3.00	Y N
K7-01	29.72	Apr-95	1289.30	1317.02	1319.02	2.00	Y N
K7-03	32.19	Apr-95	1306.90	1336.09	1339.09	3.00	Y N
K7-06	28.54	Apr-95	1385.41	1410.95	1413.95	3.00	Y N
K7-10	40.28	Apr-95	1303.03	1340.64	1343.31	2.67	Y N
K8-01	136.47	Apr-95	963.97	1098.44	1100.44	2.00	Y N
K9-01	80.62	Apr-95	994.89	1072.51	1075.51	3.00	Y N
NC2-06	54.44	Apr-95	979.07	1032.17	1033.51	1.34	Y N
NC2-08	67.02	Apr-95	985.65	1050.67	1052.67	2.00	Y N
NC2-10	68.68	Apr-95	972.03	1038.44	1040.71	2.27	Y N
NC2-11S	56.00	Apr-95	972.52	1025.52	1028.52	3.00	Y N
NC2-12S	54.97	Apr-95	973.55	1025.52	1028.52	3.00	Y N
NC2-13	48.24	Apr-95	973.26	1018.49	1021.50	3.01	Y N
NC2-14S	22.15	Apr-95	1052.79	1071.94	1074.94	3.00	Y N
NC2-19	114.78	Apr-95	977.61	1090.39	1092.39	2.00	Y N
NC2-21	38.62	Apr-95	963.52	999.14	1002.14	3.00	Y N
NC2-23	14.94	Apr-95	916.26	929.20	931.20	3.00	Y N
NC7-10	10.25	Apr-95	1216.05	1223.63	1226.30	2.67	Y N
NC7-11	20.70	Apr-95	1223.69	1241.72	1244.39	2.67	Y N
NC7-12	23.55	Apr-95	1262.14	1283.02	1285.69	2.67	Y N
NC7-17	NA	Apr-95		1385.76	1388.76	3.00	Y N
NC7-18	24.49	Apr-95	1307.77	1329.26	1332.26	3.00	Y N
NC7-19	22.36	Apr-95	1240.62	1260.98	1262.98	2.00	Y N
NC7-21	30.88	Apr-95	1273.26	1301.47	1304.14	2.67	Y N
NC7-24	DRY	Apr-95		1357.16	1359.83	2.67	Y N
NC7-28	41.07	Apr-95	1258.46	1297.53	1299.53	2.00	Y N
NC7-29	54.26	Apr-95	1200.48	1252.74	1254.74	2.00	Y N
NC7-36	DRY	Apr-95		1358.37	1361.37	3.00	Y N
NC7-37	DRY	Apr-95		1336.05	1338.72	2.67	Y N
NC7-40	25.08	Apr-95	1294.70	1317.11	1319.78	2.67	Y N
NC7-44	35.37	Apr-95	1320.76	1354.13	1356.13	2.00	Y N
NC7-45	28.83	Apr-95	1154.02	1180.18	1182.85	2.67	Y N
NC7-46	22.81	Apr-95	1108.62	1128.76	1131.43	2.67	Y N
NC7-47	62.98	Apr-95	1205.53	1265.83	1268.51	2.68	Y N
NC7-48	NA	Apr-95		1381.40	1381.77	0.37	Y N
NC7-49A	NA	Apr-95		1383.91	1384.37	0.46	Y N
NC7-51	36.49	Apr-95	1311.64	1345.13	1348.13	3.00	Y N
NC7-52	76.31	Apr-95	1292.04	1366.35	1368.35	2.00	Y N
NC7-53	33.59	Apr-95	1389.73	1421.98	1423.32	1.34	Y N

1-Apr-95

WATER LEVEL MEASUREMENT LOG

WELL DESIGNATION	DEPTH TO H2O (TOSP)	DATE H2O LEVEL TAKEN	H2O ELEVATION	SHINER ELEVATION	POM ELEVATION	TOP OF FIXED STRUCTURE	3H SAMPLE NOTES
NC7-54(*)	12.72	Apr-95	1194.53	1204.25	1207.25	3.00	Y N
NC7-56	23.25	Apr-95	1108.92	1126.86	1132.17	5.31	Y N
NC7-57	DRY	Apr-95		1101.49	1106.50	5.01	Y N
NC7-59	13.43	Apr-95	1102.33	1113.09	1115.76	2.67	Y N
NC7-61	48.38	Apr-95	1230.99	1276.70	1279.37	2.67	Y N
NC7-63	DRY	Apr-95		1346.70	1349.37	2.67	Y N
NC7-65	190.70	Apr-95	1260.58	1448.61	1451.28	2.67	Y N
NC7-68	35.33	Apr-95	1287.57	1320.23	1322.90	2.67	Y N
NC7-69	4.33	Apr-95	1246.13	1250.46	1250.46	1.76	Y N
NC7-70	35.14	Apr-95	1272.28	1304.75	1307.42	2.67	Y N
NC7-71	38.57	Apr-95	1264.65	1300.55	1303.22	2.67	Y N
NC7-72	32.64	Apr-95	1123.71	1153.68	1156.35	2.67	Y N
NC7-73	27.63	Apr-95	1138.64	1163.60	1166.27	2.67	Y N
NC7-76	23.86	Apr-95	1253.02	1274.21	1276.88	2.67	Y N
W-850-05	31.26	Apr-95	1272.13	1300.41	1303.39	2.98	Y N

NOTES:

(*)CHECK DURING RAINY SEASON-MAY SEE SATURATION

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Attachment B

Equipment Checklist

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Equipment Checklist

- _____ Two-way radio
- _____ Water-level indicator (with extra batteries)
- _____ Indicator reference bar
- _____ De-ionized water
- _____ Squirt bottle
- _____ Disposable latex gloves
- _____ Tool kit
- _____ Snake chaps (if necessary)
- _____ Appropriate maps
- _____ Field sheet
- _____ Paper towels
- _____ Pencils, pens
- _____ Detergent soap
- _____ Bucket